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# Efficiency of Antioxidants on Physiological Traits and Growth Curve of Date Palm Fruit Cultivars Barhi and Zamli

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The study aimed to investigate the impact of variety factor on the physiological characteristics and growth curve of date palm fruits in a private orchard in the Hartha district of Al-Masheeb, north of Basrah province. Two date palm varieties, Barhi and Zamli, were selected and antioxidants tocopherol and Glutathione were used at three concentrations (0, 75, 150 mg/L) for each. The interaction between these factors was studied in terms of physiological characteristics and growth curves. Results showed no significant differences between the varieties' physiological characteristics, but the spray treatments had a significant effect on the percentage of fruit set. The Glutathione spraying treatment had the highest rate of fruit set (86.60%), while the comparison treatment had the lowest drop rate (77.55%). The interaction treatments also had significant differences in drop rate and non-set fruit percentages. The Zamli variety showed the highest growth curve of physical traits (6 and 12 weeks after pollination), while antioxidant spray treatments had significant differences in the rate of physical characteristics. The interaction had a significant effect on the studied characteristics during the two growth periods.
**Keywords**: Date palm; salt stress; fruit set; dropping; growth curve.

## INTRODUCTION

The date palm (*Phoenix dactylifera* L.) is considered one of the trees that can grow vegetatively within various climatic conditions. Date palms are abundant in dry and semi-dry areas (Ibrahim, 2019). The date palm symbolises life in the desert because it can withstand high temperatures, dryness, and salinity more than many other fruit tree species (Zohary and Hopf, 2000). There are many varieties of date palms, with more than 3,000 agricultural varieties found in Arab countries, including Iraq, which has more than 600 agricultural varieties of date palms (Al-Bakr, 1972; Ibrahim, 2016). The Barhi variety is one of the varieties that grows in the southern regions of Iraq and is cultivated in many areas of Basrah Governorate. Its fruits are oval-shaped and close to spherical, with a yellow and amber color in the Khalal stage and a brownish-red color in the ripe stage. It is a medium-ripening variety (Ibrahim, 2018). The Zamli variety is a Saudi Arabian date palm variety found in Al-Ahsa, which entered Iraq in recent years. Its fruits are swollen and oval-shaped, yellow in the Khalal stage and brown in the ripe stage. Its fruits can only be eaten when cooked due to their astringent substance. In the mature stage, its fruits have a soft texture and are not dry. The Zamli variety is also medium-ripening (Al-Miyah and alasadi, 2021).

One of the biggest problems facing the agricultural sector, in general, is the problem of salt stress (salinity of irrigation water and soil salinity), especially in arid and semi-arid areas, and Iraq is at the forefront of Arab and Asian countries in terms of being affected by salinity (Batanony, 1996).

Antioxidants are substances that reduce damage resulting from reactive oxygen species (ROS), which is the number of molecules that are derived from partial oxygen O2, such as the negative ion from oxygen O2-, hydrogen peroxide H2O2, and the hydroxyl radical OH- (Turrens, 2003). The increase in the production of active oxygen species ROS at high concentrations due to salinity exposes the plant to a state of stress called oxidative stress, which is a state of imbalance between catalysts and antioxidants (Seis,2015). Therefore, the plant follows complex defence mechanisms to maintain optimum levels of ROS, consisting of an enzyme system and a non-enzymatic system. Examples of a non-enzymatic system are vitamin E called tocopherol and Glutathione (Yadav *et al*., 2014). Tocopherols are powerful fat-soluble antioxidants, and tocopherols are found in autotrophic organisms, i.e. that depend on themselves to make their food

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through photosynthesis, such as plants and algae (Mokrosnop, 2014). Glutathione also plays an essential role in cell differentiation (Henmi *et al*., 2005). Al-Salem (2022) confirmed that spraying date palm trees of the Barhi variety with three concentrations of the antioxidant (Equilibrium) (0, 3, 6 ml L-1) led to the superiority of the spraying treatment with a concentration of (6 ml L-1), as the percentage of knots reached (77.5). %) compared to the comparison treatment, which was recorded (65.5%).

While the rate of falling (14.11%) decreased compared to the comparison treatment (16.83%), the rate of unripe fruits (Shish) reached (6.2%) compared to the comparison treatment recorded (14.2%). Saddikhan (2016) indicated that spraying some environmental stressors on date palm trees of Al-Halawi variety showed significant superiority in increasing fruit length and diameter during two seasons when spraying with ascorbic acid and a concentration of (500) mg / L-1 where the average length for both seasons reached (3.73, 3.77 cm) while the diameter during the two seasons reached (2.08, 2.10 cm). Due to the recent increase in salinity and its effect on date palm trees.

This study aimed to:

- Reducing salt stress damage by increasing growth efficiency through foliar spraying with antioxidants and different concentrations to Improve quality and productivity.
- Comparing study varieties, specifically the Zamily variety, a Saudi imported variety that has not been previously studied.
- Identifying the optimal treatments for the studied date palm varieties.

## MATERIALS AND METHODS

***Experiment site*:** This study was conducted during the growth season (2022-2023) in a private orchard which located in the Al-Haritha town, Al-Masheeb area, north of Basrahh province. Two varieties of date palms were selected, the Barhi and the Zamli, and 21 palms were chosen for each variety based on their symmetry in length, size, green solid growth, and freedom from disease at the age of 6-7 years. They were planted in rows with dimensions of (10 * 10) in clayey green soil, irrigated from the Al-Masheeb River, and subjected to the same service operations. The orchard was prepared, and the selected palm trees were marked with digital signs according to the treatment and repetition.

***Service operations*:** They included fertilizing both varieties with balanced NPK fertilizer on 12.01.2023 by placing four circles around each palm tree at a depth of (30 cm), with (300 grams) per palm tree. Other service operations were carried out, including pruning, bending, weeding, and tying. As for pollination, both varieties were pollinated with green Ganami pollen from 28.03.2023 to 10.04.2023, with six flower clusters per palm tree. During June, the orchard was also treated for fungi and spider mites by spraying with agricultural sulfur, Ascor, and Kung Abamectin.

***The study included an experimental trial with two factors:***

**Factor 1**: The varieties where two varieties were used, Barhi and zamil.

**Factor 2**: The use of antioxidants (tocopherol and Glutathione) at concentrations of 0, 75, and 150 mg/L for each and their interaction. The spraying solutions were prepared by dissolving 75 and 150 mg/L in distilled water, with 0.1% of the surfactant Tween20 (to reduce surface tension). As for the control treatment, distilled water with Tween 20 was used. The spraying was done on the vegetative and fruiting parts early in the morning, with (six sprays) starting from 10.10.2022, with 30-day intervals between each spray until the last spray on 09.06.2023. The treatments were as follows:

1. Control treatment (without addition).
2. Tocopherol treatment (75 mg/L).
3. Tocopherol treatment (150 mg/L).
4. Glutathione treatment (75 mg/L).
5. Glutathione treatment (150 mg/L).
6. Interaction treatment (tocopherol 75 mg/L + Glutathione 75 mg/L).
7. Interaction treatment (tocopherol 150 mg/L + Glutathione 150 mg/L).

***The Studied Characteristics:***

***1- Physiological traits***

*1-* ***The percentage of fruit set (%):*** Based on the Ream and Furr (1970) method, the percentage of fruit set was determined by calculating the number of set fruits and the number of empty receptacles on five random spikes from each tiller, using the following equation: -

Fruit set %= 100 x (number of set fruits) / (number of empty receptacles + number of set fruits)

*2-* ***The percentage of fruit drop (%):*** The percentage of fruit drop was calculated in three stages: the first stage after fruit set, the second stage in June (June drop), and the third stage during harvesting, using the following equation:

Fruit drop % = 100 x (number of remaining fruits - number of set fruits) / number of set fruits

*3-* ***The percentage of non-set fruits (chaff) (%)*:** The percentage of non-set fruits is calculated using the following equation:

Chaff (%) = 100 x (number of non-set fruits) / (total number of fruits)

***2-The growth curve for some physical characteristics of fruits during two stages (after 6 and 12 weeks of fertilization):***

*1-* ***Size, length, and diameter of the fruit:*** Ten fruits were randomly selected for each experimental unit (palm tree), and their size was determined using the water displacement method with a graduated cylinder by filling it with water up to a certain level and then placing the fruits in it. The average size of the fruit was calculated using the following equation:

(water displacement volume) / (number of fruits) (cm) average fruit size. The length and diameter of the fruit were measured using an electronic measuring foot (Vernier Caliper).

***Statistical analysis*:** The experiment was conducted according to the design of the complete randomized blocks and with three replicates. The number of date palm trees used in the experiment was 42, including both Barhi and Zamli varieties. The data were statistically analyzed using (GenStat 2009) software, and the means were compared using the LSD test at a significance level of 0.05, based on (Al-Rawi and Khalef Allah, 2000).

## RESULTS AND DISCUSSION

Physiological traits

***Percentage of fruit set (%):*** The results shown in Table 1 indicate no significant differences between the Barhi and Zamli cultivars in the percentage of fruit set, with values of 80.62% and 82.23%, respectively. Additionally, the results show that the spraying treatments had a significant effect on the percentage of fruit set, with glutathione treatment at a concentration of 150 mg/L showing the highest rate of 86.60%, followed by the tocopherol spray treatment at a concentration of 75 mg/L, which recorded a rate of 83.39%. The comparison treatment had the lowest percentage of fruit set at 77.75%. As for the effect of the interaction between the cultivar and the antioxidants, the results showed that the treatment of tocopherol + Glutathione at a concentration of 150 mg/L was superior with the Zamli cultivar, recording the highest rate of fruit set at 90.12%. There was no significant difference between glutathione treatment at a concentration of 150 mg/L with the Barhi cultivar, which recorded a rate of 89.24%, compared to other treatments and the comparison treatment with the Barhi cultivar, which recorded a rate of 72.37%.

***Drop percentage (%)*:** The results shown in Table 2 indicate no significant differences in the average drop percentage between the two study cultivars, where drop percentage for the Barhi cultivar was 19.73%, while it was 17.75% in the Zamli cultivar. The results in the same table also indicated significant differences in drop percentage when treated with antioxidants, where the comparison treatment recorded the highest drop percentage of 23.70%. In contrast, the treatment with spraying with 150 mg/L of Glutathione recorded the lowest percentage of drop, which was 13.90%. The results in the table also showed significant differences in the interaction effect, where the interaction treatment (tocopherol + Glutathione 150 mg/L) with the Zamli cultivar had the lowest drop rate, which was 9.88%. They did not differ significantly from the Glutathione spraying treatment with a concentration of 150 mg/L and the Barhi cultivar, where drop percentage was 10.75%. In contrast, the interaction comparison treatment with the Barhi cultivar recorded the highest drop rate, which was 27.66%.

**Table 1. Effect of cultivar and efficiency of antioxidants and their interaction on the percentage of fruit set (%) of the two cultivars of tissue culture date palm.**

| Antioxidants | Variety | | |
|---|---|---|---|
| | Barhi | Zamli | Antioxidants mean |
| Control treatment | 72.37 | 76.15 | 77.75 |
| Tocopherol (75 mg l-1) | 81.86 | 84.92 | 83.39 |
| Tocopherol (150 mg l- | 88.33 | 76.98 | 82.24 |
| Glutathione (75 mg l-) | 79.41 | 76.85 | 78.13 |
| Glutathione (150 mg l- | 89.24 | 83.95 | 86.60 |
| Tocopherol + Glutathione (75 mg l-1) | 74.67 | 86.67 | 80.67 |
| Tocopherol + Glutathione (150 mg l-) | 78.52 | 90.12 | 81.23 |
| interaction LSD5% | 5.88 | | Antioxidants LSD5% |
| Varieties Average | 80.62 | 82.23 | 4.158 |
| Variety LSD5% | NS | | |

**Table 2. Effect of cultivar and efficiency of antioxidants and their interaction on drop percentage (%) of the two cultivars of tissue culture date palm.**

| Antioxidants | Variety | | |
|---|---|---|---|
| | Barhi | Zamli | Antioxidants mean |
| Control treatment | 27.66 | 23.60 | 23.70 |
| Tocopherol (75 mg l-1) | 18.14 | 15.07 | 16.61 |
| Tocopherol (150 mg l- | 15.01 | 22.63 | 18.82 |
| Glutathione (75 mg l-) | 21.98 | 23.02 | 22.79 |
| Glutathione (150 mg l- | 10.75 | 17.05 | 13.90 |
| Tocopherol + Glutathione (75 mg l-1) | 20.16 | 13.03 | 16.60 |
| Tocopherol + Glutathione (150 mg l-) | 24.38 | 9.88 | 18.77 |
| interaction LSD5% | 5.97 | | Antioxidants LSD5% |
| Varieties Average | 19.73 | 17.75 | 4.22 |
| Variety LSD5% | NS | | |

***Percentage of non-set fruits (porcupine) (%):*** The results in Table 3 show the effect of spraying with tocopherol and Glutathione on date palm trees of the Barhi and Zamili varieties and the interaction between them in the rate of the percentage of porcupine. The table shows that there are no significant differences between the varieties, as the percentage of porcupine in the Barhi variety reached (3.7%), while it reached (3.7%) in the Zamili variety ( 0.0%). It is also noted from the results of the same table that there are no significant differences between the concentrations of the treatments, as the highest percentage of porcupine was reached in the comparison treatment (5.6%). As for the effect of the binary interaction, the table shows no significant differences in the average percentage of porcupine, as in the

comparison treatment and the variety. Al-Barhi had the highest rate recorded (11.1%).

**Table 3. Effect of cultivar and efficiency of antioxidants and their interaction on a percentage of non-set fruits (porcupine) (%) of the two cultivars of tissue culture date palm.**

| Antioxidants | Variety | | |
|---|---|---|---|
| | Barhi | Zamli | Antioxidants mean |
| Control treatment | 11.1 | 0.0 | 5.6 |
| Tocopherol (75 mg l-1) | 7.1 | 0.0 | 3.6 |
| Tocopherol (150 mg l- | 0.0 | 0.0 | 0.0 |
| Glutathione (75 mg l-) | 0.0 | 0.0 | 0.0 |
| Glutathione (150 mg l- | 0.0 | 0.0 | 0.0 |
| Tocopherol + Glutathione (75 mg l-1) | 8.0 | 0.0 | 0.0 |
| Tocopherol + Glutathione (150 mg l-) | 0.0 | 0.0 | 0.0 |
| interaction LSD5% | NS | | Antioxidants LSD5% |
| Varieties Average | 3.7 | 0.0 | NS |
| Variety LSD5% | NS | | |

The results of Tables 1, 2, 3 showed that the use of antioxidants at different concentrations had a significant effect in improving and increasing the set rate, decreasing the drop rate, and recording low rates of non-set fruits (porcupines) because antioxidants work to increase the activity of the enzymes responsible for construction processes. Photosynthesis and an increase in the activity of hormones responsible for growth, such as auxins, gibberellins, and cytokinins, and thus the accumulation of carbohydrates, which results in a lack of competition between fruits for nutrients. Therefore, a nutritional balance occurs within the fruits. Antioxidants also work to inhibit the activity of ethylene, which leads to a decrease in the rate of shedding, an increase in the rate of setting, and a lack of fruits. The reason may also be service operations, such as pollination with high-vitality pollen, bagging, and control (Al-Rubaie, 2021). It was also clear from the results of the same tables that the comparison treatment for both cultivars recorded an increase in the percentage of drop and the rate of non-setting fruits and a decrease in the percentage of settling. The reason is attributed to salt stress, which leads to a hormonal imbalance within the plant, where there is a drop in the levels of growth-encouraging hormones such as auxins. And gibberellins and an increase in the levels of growth-inhibiting hormones such as abscisic acid (Munns and Tester, 2008; Abd *et al.*, 2020). Or perhaps the reason is due to the decrease in the absorption of potassium from the soil due to the opposition with sodium and the effect on the opening and closing of stomata and the occurrence of a decrease in the diffusion of CO2 to Leaves, which negatively affect the production of manufactured materials such as carbohydrates and proteins, which are the cornerstone for the formation of hormones (Munns, 2002; Taiz and Zieger, 2006).

***2. Growth curve of some physical characteristics of fruits during two stages (6 and 12 weeks after pollination)***

***1- Volume (cm3) during two periods, 6 and 12 weeks after vaccination***

The results listed in Tables 4 and 5 show that there are significant differences between the varieties for size during the two periods, as the Zamili variety was significantly superior to the Barhi variety, which reached fruit size during the two periods (1.047, 6.79 cm3), respectively, compared to the Barhi variety, which recorded during the two periods (0.512, 3.77 cm3). It was also evident from the same results that there were no significant differences between the concentrations of the treatments for the two periods after 6 and 12 weeks. As for the interaction treatments between the variety and the concentrations of antioxidants for the two periods, the numbers recorded in the table indicate the presence of significant differences, as the interaction treatment between the Zamili variety and the treatment with concentration 150 was superior. mg l-1 tocopherol, where the volume reached (1.311 cm3), while the interaction treatment between the Barhi variety and concentration (75 mg l-1 of Glutathione + 75 mg l-1 of tocopherol) recorded the lowest fruit volume of (0.400 cm3) compared to the interaction treatment between Comparison and Barhi, which recorded the lowest average fruit volume of (0.272 cm3) during the first period. However, in the second period, the results showed that there were also significant differences between the intervention treatments. The intervention treatment excelled between the Zamili variety and the treatment with a concentration of 75 mg L-1 of Glutathione, at which the volume reached (8.00 cm3).

**Table 4. Effect of cultivar and efficiency of antioxidants and their interaction on average fruit size (cm3) after (6) weeks of pollination of tissue culture date palm.**

| Antioxidants | Variety | | |
|---|---|---|---|
| | Barhi | Zamli | Antioxidants mean |
| Control treatment | 0.272 | 0.672 | 0.619 |
| Tocopherol (75 mg l-1) | 0.547 | 0.957 | 0.752 |
| Tocopherol (150 mg l- | 0.667 | 1.311 | 0.989 |
| Glutathione (75 mg l-) | 0.468 | 1.063 | 0.766 |
| Glutathione (150 mg l- | 0.547 | 1.225 | 0.748 |
| Tocopherol + Glutathione (75 mg l-1) | 0.400 | 1.133 | 0.767 |
| Tocopherol + Glutathione (150 mg l-) | 0.667 | 0.967 | 0.817 |
| interaction LSD5% | 0.370 | | Antioxidants LSD5% |
| Varieties Average | 0.512 | 1.047 | NS |
| Variety LSD5% | 0.140 | | |

**Table 5. Effect of cultivar and efficiency of antioxidants and their interaction on average fruit size (cm3) After (12) weeks of pollination of the two cultivars of tissue culture date palm.**

| Antioxidants | Variety | | |
|---|---|---|---|
| | Barhi | Zamli | Antioxidants mean |
| Control treatment | 2.63 | 5.06 | 4.35 |
| Tocopherol (75 mg l-1) | 4.33 | 6.73 | 5.53 |
| Tocopherol (150 mg l- | 3.80 | 7.60 | 5.70 |
| Glutathione (75 mg l-) | 4.00 | 8.00 | 6.00 |
| Glutathione (150 mg l- | 3.63 | 7.27 | 4.95 |
| Tocopherol + Glutathione (75 mg l-1) | 4.30 | 6.33 | 5.32 |
| Tocopherol + Glutathione (150 mg l-) | 3.67 | 6.53 | 5.10 |
| interaction LSD5% | 1.76 | | Antioxidants LSD5% |
| Varieties Average | 3.77 | 6.79 | NS |
| Variety LSD5% | 0.66 | | |

In comparison, the interaction treatment between the Barhi variety and the concentration of 150 mg L-1 of Glutathione recorded the lowest fruit volume, amounting to (3.63 cm3), compared to the interaction treatment between the comparison and the Barhi variety, which recorded the lowest average fruit size, amounting to (2.63 cm3) during the second period.

***2. Height (cm) during two periods after 6 and 12 weeks after fertilization*:** Can note from Tables 6 and 7 that the effect of the variety and the efficiency of antioxidants and the interaction between them on the average length of the fruit is clear, as we note the superiority of the Zamili variety over the Barhi variety in the average fruit length, which reached (1,150 and 2,682 cm) during the two periods, while it reached the Barhi variety for the two periods. (0.810, 1.853 cm) sequentially. As for treating the different concentrations of antioxidants, the table results indicated no significant differences between the concentrations during the periods 6 and 12 weeks after pollination. The results also showed that there were significant differences in the interaction coefficients between the variety and the different antioxidant concentrations during the first period; it became clear that the interaction between the Zamili variety and the concentration of 75 mg L-1 of Glutathione was superior to the rest of the treatments, as the average length of the fruit reached (1.279 cm), which did not differ significantly from the interaction treatment between the Zamili variety and the concentration of 150 mg L-1 of tocopherol, where The average fruit length was (1.274 cm), while the significant difference was in the interaction between the Barhi variety and the concentration (150 mg L-1 tocopherol), where the lowest average fruit length was recorded (0.775 cm) compared to the interaction treatment between the comparison and the Barhi variety, which recorded the lowest average fruit length reach (0.768 cm).

As for the second period, the table showed that the interaction between the Zamili cultivar and the concentration of 75 mg L-1 of Glutathione outperformed the rest of the treatments and recorded the highest average fruit length (2.943 cm), which did not differ significantly from the interaction between the Zamili cultivar and the concentration 150 mg L-1 of Glutathione, which had an average fruit length of (2.870 cm), while the interaction treatment between the Barhi cultivar and a concentration of 150 mg L-1 of Glutathione recorded the lowest average fruit length of (1.807 cm) compared to the comparison treatment with the Barhi cultivar, which recorded the lowest average fruit length. It reached (1.650 cm).

**Table 6. Effect of cultivar and efficiency of antioxidants and their interaction on an average length of the fruit (cm) after (6) weeks of the two cultivars of tissue culture date palm.**

| Antioxidants | Variety | | |
|---|---|---|---|
| | Barhi | Zamli | Antioxidants mean |
| Control treatment | 0.768 | 0.943 | 0.911 |
| Tocopherol (75 mg l-1) | 0.843 | 1.127 | 0.985 |
| Tocopherol (150 mg l- | 0.807 | 1.274 | 1.040 |
| Glutathione (75 mg l-) | 0.860 | 1.279 | 1.070 |
| Glutathione (150 mg l- | 0.775 | 1.269 | 1.022 |
| Tocopherol + Glutathione (75 mg l-1) | 0.878 | 1.043 | 0.905 |
| Tocopherol + Glutathione (150 mg l-) | 0.810 | 1.113 | 0.961 |
| interaction LSD5% | 0.129 | | Antioxidants LSD5% |
| Varieties Average | 0.820 | 1.150 | NS |
| Variety LSD5% | 0.120 | | |

**Table 7. Effect of cultivar and efficiency of antioxidants and their interaction on average length of the fruit (cm) after (12) weeks of the two cultivars of tissue culture date palm.**

| Antioxidants | Variety | | |
|---|---|---|---|
| | Barhi | Zamli | Antioxidants mean |
| Control treatment | 1.650 | 2.197 | 2.002 |
| Tocopherol (75 mg l-1) | 1.950 | 2.720 | 2.335 |
| Tocopherol (150 mg l- | 1.887 | 2.800 | 2.343 |
| Glutathione (75 mg l-) | 1.980 | 2.943 | 2.462 |
| Glutathione (150 mg l- | 1.807 | 2.870 | 2.260 |
| Tocopherol + Glutathione (75 mg l-1) | 1.850 | 2.527 | 2.188 |
| Tocopherol + Glutathione (150 mg l-) | 1.850 | 2.717 | 2.283 |
| interaction LSD5% | 0.317 | | Antioxidants LSD5% |
| Varieties Average | 1.853 | 2.682 | NS |
| Variety LSD5% | 0.120 | | |

***3. Diameter (cm) during two periods, 6 and 12 weeks after fertilization*:** The results in Tables 8 and 9 indicate that there is a significant effect for cultivars on the average fruit diameter, where the Zamili cultivar was significantly superior to the Barhi cultivar, as the average fruit diameter for the two

periods was (1.079, 2.120 cm), while it was in the Barhi cultivar for the two periods (0.918, 1.799 cm) sequentially.

**Table 8. Effect of cultivar and efficiency of antioxidants and their interaction on average fruit diameter (cm) after (6) weeks of the two cultivars of tissue culture date palm.**

| Antioxidants | Variety | | |
|---|---|---|---|
| | Barhi | Zamli | Antioxidants mean |
| Control treatment | 0.849 | 0.933 | 0.935 |
| Tocopherol (75 mg l-1) | 0.966 | 1.037 | 1.002 |
| Tocopherol (150 mg l- | 0.898 | 1.186 | 1.042 |
| Glutathione (75 mg l-) | 0.938 | 1.144 | 1.041 |
| Glutathione (150 mg l- | 1.002 | 1.172 | 1.010 |
| Tocopherol + Glutathione (75 mg l-1) | 0.858 | 1.012 | 0.968 |
| Tocopherol + Glutathione (150 mg l-) | 0.912 | 1.070 | 0.991 |
| interaction LSD5% | 0.114 | | Antioxidants LSD5% |
| Varieties Average | 0.912 | 1.079 | NS |
| Variety LSD5% | 0.043 | | |

**Table 9. Effect of cultivar and efficiency of antioxidants and their interaction average fruit diameter (cm) after (12) weeks of the two cultivars of tissue culture date palm.**

| Antioxidants | Variety | | |
|---|---|---|---|
| | Barhi | Zamli | Antioxidants mean |
| Control treatment | 1.580 | 1.983 | 1.813 |
| Tocopherol (75 mg l-1) | 1.930 | 2.113 | 2.022 |
| Tocopherol (150 mg l- | 1.850 | 2.193 | 2.022 |
| Glutathione (75 mg l-) | 1.857 | 2.160 | 2.008 |
| Glutathione (150 mg l- | 1.643 | 2.240 | 1.910 |
| Tocopherol + Glutathione (75 mg l-1) | 1.945 | 2.070 | 1.995 |
| Tocopherol + Glutathione (150 mg l-) | 1.813 | 2.077 | 1.945 |
| interaction LSD5% | 0.194 | | Antioxidants LSD5% |
| Varieties Average | 1.799 | 2.120 | NS |
| Variety LSD5% | 0.073 | | |

It is clear from the same table that there were no significant differences in the treatment with different concentrations of antioxidants for the two periods in succession. The interaction coefficients between the variety and the concentrations of different antioxidants indicated that there were significant differences for the two periods, as the interaction treatment between the Zamli variety and the concentration of 150 mg L-1 of tocopherol excelled, which had an average diameter of (1.186, 2.193 cm) respectively, while the interaction treatment between the Barhi cultivar and the concentration of 75 mg L-1 of Glutathione + 75 mg L-1 of tocopherol recorded the lowest rate of fruit diameter amounted to (0.858 cm) during the first period, while it recorded The interaction treatment between the Barhi cultivar and the concentration of 150 mg L-1 of Glutathione, the lowest average fruit diameter reached (1.643 cm) during the second period, compared to the interaction treatment between the Barhi cultivar and the comparison treatment, which recorded the lowest average fruit diameter during the two periods (0.849, 1.580 cm), respectively.

It was clear from the results of tables 4, 5, 6, 7, 8, 9 that there were significant differences between the two cultivars of Barhi and Zamli under the influence of salt stress in the characteristics of the growth curve (size, length and diameter of fruits) and for two periods after (6 and 12) weeks of pollination. The reason is the difference in the genetic makeup of the two study cultivars, according to their tolerance to the degree of salinity through resistance methods, which may be reducing the permeability of toxic ions in the root zone, especially the sodium and chloride ions, which leads to the readiness of the elements to be absorbed by the root zone and thus leads to nutritional and hormonal balance within the plant by preserving On a high ratio of potassium to sodium, which is considered one of the necessary foundations for resisting salinity (Marschner, 2011). This positively affected the fruits' physical

characteristics, which is consistent with the study (Al-Rawi and Al-Mohemdy, 2001; Altemimy et al., 2019). It was also shown through the same tables that there was an increase in the characteristics of the growth curve when using antioxidants. The reason may be attributed to the role of antioxidants in increasing the strength of vegetative growth, leafy area and chlorophyll content, thus increasing the amount of nutrients for each fruit. Antioxidants also work in increasing the activity of auxins and cytokinins. And gibberellins, which lead to an increase in cell division and expansion activity, lead to an increase in the fruit's size, length and diameter (Al-Nomani, 2013).

***Conclusion:*** The study found no significant differences in physiological characteristics between the two varieties. However, the spray treatments significantly affected fruit set percentages, with Glutathione having the highest rate at 150 mg/L. The interaction between the variety and antioxidants also affected fruit set ratios, but not non-set fruits. The Zamli variety showed the highest growth rate in length, diameter, and size.

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